

AMENDMENTS TO THE CLAIMS

1. (Withdrawn) A rubber-reinforced structure which comprises at least one resin member comprising a resin composition, and at least one rubber layer or rubber member being directly bonded to the resin member without any adhesive, wherein the resin member and the rubber layer or rubber member form a tire, the rubber layer or rubber member comprises a rubber composition vulcanized with a radical-generating agent, the resin member comprises a thermoplastic resin having at least two active atoms on the average per molecule, and each of the atoms is selected from the group consisting of a hydrogen atom and a sulfur atom and has an orbital interaction energy coefficient S of not less than 0.006,

wherein the orbital interaction energy coefficient S is represented by the following formula (1):

$$S = (C_{HOMO,n})^2 / |E_c - E_{HOMO,n}| + (C_{LUMO,n})^2 / |E_c - E_{LUMO,n}| \quad (1)$$

in the formula, each of factors, E_c , $C_{HOMO,n}$, $E_{HOMO,n}$, $C_{LUMO,n}$, and $E_{LUMO,n}$ represents a value calculated by a semiempirical molecular orbital method MOPACPM3, E_c representing an orbital energy (eV) of a radical of the radical-generating agent as a vulcanizing agent, $C_{HOMO,n}$ representing a molecular-orbital coefficient of the highest occupied molecular orbital (HOMO) of an n-th active atom constituting a basic unit of the thermoplastic resin, $E_{HOMO,n}$ representing an orbital energy (eV) of the HOMO, $C_{LUMO,n}$ representing a molecular-orbital coefficient of the lowest unoccupied molecular orbital (LUMO) of the n-th active atom

constituting the basic unit of the thermoplastic resin, and $E_{LUMO,n}$ representing an orbital energy (eV) of the LUMO.

2. ((Original) A rubber-reinforced structure which comprises at least one resin member comprising a resin composition, and at least one rubber member being directly bonded to the resin member without any adhesive, wherein the resin member and the rubber member form a tire, the rubber member comprises a rubber composition vulcanized with a sulfur-containing vulcanizing agent or a radical-generating agent, and the resin member comprises at least one member selected from the group consisting of a thermoplastic resin and a resin having a crosslinkable group.

3. (Withdrawn) A rubber-reinforced structure according to claim 2, wherein the rubber member comprises a styrene-diene-series rubber composition vulcanized with a sulfur-containing vulcanizing agent or a rubber composition vulcanized with a radical-generating agent, and the resin member comprises a polyphenylene ether-series resin composition.

4. (Original) A rubber-reinforced structure according to any one of claims 1 to 3, wherein the resin member comprises a reinforcing layer of the tire.

5. (Original) A rubber-reinforced structure according to any one of claims 1 to 3, wherein the resin member forms an adhesive layer to at least one rubber layer or rubber member constituting the tire.

6. (Original) A rubber-reinforced structure according to any one of claims 1 to 3, wherein the resin member is bonded to the rubber member through a vulcanized rubber layer vulcanized with a vulcanizing agent.

7. (Currently Amended) A rubber-reinforced structure according to any one of claims 1 to 3, wherein the thermoplastic resin comprises at least one member selected from the group consisting of a polyamide-series resin, a polyester-series resin, a poly(thio)ether-series polythioether-series resin, a polycarbonate-series resin, a polyimide-series resin, a polysulfone-series resin, a polyurethane-series resin, a polyolefinic resin, a halogen-containing vinyl-series resin, a styrenic resin, a (meth)acrylic methacrylic resin, and a thermoplastic elastomer.

8. (Original) A rubber-reinforced structure according to any one of claims 1 to 3, wherein the thermoplastic resin comprises at least one member selected from the group consisting of an aliphatic polyamide-series resin, an aromatic polyester-series resin, a polyacetal-series resin, a polyphenylene ether-series resin, a polysulfide-series resin, a polyurethane-series resin, a polyolefinic resin, a polyamide-series elastomer, a polyester-series elastomer, a polyurethane-series elastomer, a polystyrenic elastomer, and a polyolefinic elastomer.

9. (Withdrawn) A rubber-reinforced structure according to claim 2, wherein the resin having a crosslinkable group comprises at least one member selected from the group consisting of a thermosetting resin, and a thermoplastic resin having an unsaturated bond.

10. (Withdrawn) A rubber-reinforced structure according to any one of claims 1 to 3, wherein the rubber vulcanizable with the radical-generating agent comprises at least one member selected from the group consisting of a diene-series rubber, an olefinic rubber, an acrylic rubber, a fluorine-containing rubber, a silicone-series rubber, and a urethane-series rubber.

11. (Withdrawn) A rubber-reinforced structure according to any one of claims 1 to 3, wherein the radical-generating agent comprises at least one member selected from the group consisting of an organic peroxide, an azo compound, and a sulfur-containing organic compound.

12. (Original) A rubber-reinforced structure according to claim 1 or 2, wherein at least one member selected from the group consisting of the rubber member and the resin member is formed from a composition containing a vulcanization-activating agent.

13. (Original) A rubber-reinforced structure according to claim 12, wherein the vulcanization-activating agent has a plurality of polymerizable groups.

14. (Original) A rubber-reinforced structure according to claim 12, wherein the amount of the vulcanization-activating agent is 0.1 to 10 parts by weight relative to 100 parts by weight of the rubber or the resin.

15. (Original) A rubber-reinforced structure according to claim 12, wherein the amount of the vulcanization-activating agent is not more than 2 parts by weight relative to 100 parts by weight of the rubber.

16. (Original) A process for producing a rubber-reinforced structure which comprises bringing a resin element for forming a resin member into contact with at least one rubber element, wherein the resin element is selected from the group consisting of an unmolded resin composition, a semi-molded resin member and a molded resin member, the rubber element is selected from the group consisting of an unvulcanized rubber composition and a semi-vulcanized rubber member, and the resin member and the rubber element form a tire, vulcanizing an unvulcanized rubber of the rubber element to bond the formed vulcanized rubber member to the resin member, wherein the resin element and the rubber element are used in any one of the following combinations:

(i) a combination of a rubber element containing a radical-generating agent, and a resin element containing a thermoplastic resin having at least two active atoms on the average per molecule, wherein each of the atoms is selected from the group consisting of a hydrogen atom

and a sulfur atom and has an orbital interaction energy coefficient S represented by the formula

(1) recited in claim 1 of not less than 0.006;

(ii) a combination of a rubber composition containing a sulfur-containing vulcanizing agent or a radical-generating agent, and a resin composition containing at least one resin selected from a thermoplastic resin and a resin having a crosslinkable group; or

(iii) a combination of a styrene-diene-series rubber composition containing a sulfur-containing vulcanizing agent or a rubber composition containing a radical-generating agent, and a resin composition containing a polyphenylene ether-series resin.

17. (Original) A process according to claim 16, wherein at least one element of the resin element and the rubber element contains a vulcanization-activating agent.

18. (Withdrawn) A process according to claim 16, wherein the resin element comprises a vulcanization auxiliary comprising a compound having at least two active atoms on the average per molecule, wherein each of the atoms is selected from the group consisting of a hydrogen atom and a sulfur atom and has an orbital interaction energy coefficient S represented by the formula (1) recited in claim 1 of not less than 0.006.

19. (Original) A process according to claim 16, wherein the resin element and the rubber element are heat-molded with a vulcanization-activating agent interposing therebetween to bond the formed resin member to the formed rubber member.

20. (Withdrawn) A process according to claim 16, wherein the resin element and the rubber element are heat-molded with a coating layer containing a vulcanization-activating agent and a vulcanization auxiliary interposing on the contact surface of the resin element with the rubber element to bond the formed resin member to the formed rubber member, wherein the vulcanization auxiliary comprises a compound having at least two active atoms on the average per molecule, wherein each of the atoms is selected from the group consisting of a hydrogen atom and a sulfur atom and has an orbital interaction energy coefficient S represented by the formula (1) recited in claim 1 of not less than 0.006.

21. (Withdrawn) A process for producing a rubber-reinforced structure, which comprises a step for bonding a resin member to at least one rubber element, wherein the resin member is selected from the group consisting of a semi-molded resin member and a molded resin member, the rubber element is selected from the group consisting of an unvulcanized rubber composition and a semi-vulcanized rubber member, and the resin member and the rubber element form a tire, and

the bonding step comprises treating the surface of the resin member with a solvent capable of dissolving or swelling the resin member, bringing the treated surface of the resin member into contact with the rubber element, and vulcanizing an unvulcanized rubber of the rubber component to bond the vulcanized and formed rubber member to the resin member.

22. (New) The process according to claim 16, wherein the vulcanization-activating agent is at least one agent of a maleimide-series compound having a plurality of maleimide groups, a trialkyl (iso)cianurate and a multifunctional (meth)acrylate.

23. (New) The process according to claim 16, wherein the amount of the vulcanization-activating agent is 0.1 to 10 parts by weight relative to 100 parts by weight of the rubber or the resin.

24. (New) The process according to claim 16, wherein the amount of the vulcanization-activating agent is not more than 2 parts by weight relative to 100 parts by weight of the rubber.

25. (New) A tire containing the rubber reinforcing structure of claim 16.

26. (New) A process for producing a rubber-reinforced structure which comprises:
treating the surface of a polyamide-series resin element selected from the group consisting of an unmolded resin composition, a semi-molded resin layer and a molded resin layer with a solvent capable of dissolving or swelling the resin element to form a resin layer;
forming a rubber layer selected from the group consisting of an unvulcanized rubber composition and a semi-vulcanized rubber composition, which contain a sulfur-containing vulcanizing agent; and

vulcanizing the unvulcanized rubber of the rubber layer to bind the rubber layer to the resin layer in the substantial absence of an adhesive to form the rubber reinforced structure, wherin at least one of the resin layer and the rubber layer contains a vulcanization-activating agent comprising at least one agent of an organic compound having a carbon-carbon bond and a maleimide-series compound.